

SEISMIC AND ITS EFFECTS ON FISH

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Western Region

Fisheries and Marine Service

Evidence prepared for the Berger Inquiry

On Behalf of C.O.P.E.

MACKINAC VALLEY PIPELINE INDUSTRY
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Prepared testimony for
Mackenzie Valley Pipeline Hearings

The Oil and Gas industry, mining industry and various agencies of the Federal government have been actively involved in the development of the resources of the N.W.T. for many years. The Department of Fisheries became involved with the commercial fishery on Great Slave Lake almost 30 years ago and has had personnel stationed in the N.W.T. since that time. It was not until 1971, however, that the Department became actively involved with the industrial activities associated with the search for oil and gas reserves. Prior to that time, involvement was minimal and usually related to problems associated with the use of explosives in lakes or the construction by industry of temporary crossings of rivers to gain access to areas of interest.

Until 1971, there was no requirement for industry to submit plans for forthcoming programs, to report their presence in the field or to report any problems encountered which might have an effect on the aquatic environment. It was left to the Department to detect these activities in the field by conducting patrols usually associated with commercial fisheries and take the necessary action to prevent or rectify problems which might occur. There was a small force of Fishery Officers located in Hay River with a small operation budget to work with and the whole of the N.W.T. to be covered. The Department's activities were necessarily geared to commercial fisheries. It is not

surprising, therefore, that little attention was paid to the industrial activities which were taking place.

The discovery of oil and gas in Alaska in 1967 added a new impetus to the search for hydrocarbon fuels in the N.W.T. and the level of activity increased quickly. The Department of Fisheries concern was growing as the industrial activity increased and by 1970/71 there were plans to establish offices in Ft. Simpson and Inuvik in order to better regulate these activities from the point of view of protecting the fishery resources of the N.W.T. These offices were finally established and manned in 1971/72.

The district headquarters was moved to Yellowknife in 1971. This office is staffed by the District Manager, Chief of Enforcement, an administration support staff and three Fishery Officers. The Hay River Station is our largest single facility in the N.W.T. containing lab, offices and equipment maintenance facilities.

At the same time, a set of guidelines was prepared indicating the Department's concern and giving guidance to industry to enable them to comply with the legislation then in effect. A system of reporting proposed activities was incorporated in the guideline which would permit the Department a chance to review, assess and respond to each program in advance thus hopefully avoiding problems in the field.

This guideline was no sooner distributed to industry



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than the Department of Indian and Northern Affairs enacted their Land Use Act and Regulations and began a similar exercise. It was then agreed to use this legislation and the resultant Land Use Advisory Committee as the focal point for submissions from industry to government and to include the Department of Fisheries requirements in the conditions of the Land Use Permit. This was a beneficial arrangement to both industry and government as it saved a great deal of expense in administrative costs and unnecessary duplication and delay in processing.

The Land Use Advisory Committee has been criticized many times and from many quarters since it's inception in 1971(?) but in fairness to those who set it up and got it working it must be viewed as a success. In the last four years it has processed hundreds of applications and tried to follow each program through to completion ensuring that minimal environmental damage takes place. It has not always been successful, however, and it is the failures of the system which get the greatest public attention.

The evolutionary process which has taken place in this committee over the past four years should continue. As the member agencies gain experience the benefits to all concerned should be realized in realistic conditions attached to Land Use Permits which will permit the best use of resources with minimal environmental effects.

Programs which were to be conducted in the aquatic environment required a licence from the Department of Fisheries

if explosives were to be used Sect. 5(5) N.W.T. Fishery Regulations (then Sect. 4(8) N.W.T. Fishery Regulations). In most cases this involved extensions of land seismic programs across rivers and lakes. As the search for hydrocarbons extended off the Arctic Coast into the Beaufort Sea, this licence became the only Authorization required as it was outside the terms of reference of the Northern Inland Waters Act and the N.W.T. Land Use Act. In most cases, however, these offshore programs are submitted to the Land Use Committee for response as well as to the Fisheries and Marine Service for the issuance of the licence. The applications are distributed to the member agencies for comment and a letter is sent by DINA pointing out the concerns expressed by the committee and usually suggesting conditions which should apply to the program.

Before I discuss the most obvious fisheries problems associated with marine seismic work I would like to briefly outline some of the fisheries problems associated with land seismic.

The areas in which this type of activity takes place are almost always difficult to get to. In gaining access to remote areas it is necessary to clear trails through brush and cross rivers and lakes and here serious damage can be done. The practice before Fisheries got involved was to simply bulldoze logs, brush, dirt as well as snow and ice into the stream to construct a temporary bridge. These crossings were left to be removed by the spring flood. We found, however, that these crossings did not wash out quickly and in some cases, logs and trees were still in place many years later. Initially these crossings act

as dams causing flooding upstream and resulting in destruction of vegetation and erosion of the banks. They may also destroy fish spawn on the downstream side by restricting the flow of water. When the crossing does finally wash out, the debris and sediment may cover spawning areas or the siltation delay spawning runs into the stream. Cuts made on the banks result in long term erosion and downstream siltation problems which could last for several years depending on how quickly the area re-vegetates. In the Delta, this damming action may prevent the annual inflow of water into perched lakes during spring floods.

One crossing if considered alone, does not represent what would be called a serious environmental problem. Each industry program, however, results in many crossings of (many) streams and in some cases several crossings of the same stream. This situation multiplied by the number of operators and programs per year starts to take on significant proportions and obviously had to be controlled. Operators are now required to preserve the layer of vegetation on slopes to rivers and lakes. They can land use snow and pumped water to form ice bridges at crossing sites and these have to be removed upon completion of the program. In the few cases where reinforcement is required, limbed trees may be used if authorized by a Fishery Officer and these must be removed before break-up. Although there are still many log jams across creeks resulting from crossings constructed prior to 1971, I am quite confident that this situation has been rectified. It is still necessary every year to remind operators of their requirement to remove ice and snow crossings before the end of the

operating season.

A secondary potential effect of seismic on the fisheries is pollution of water bodies by fuel spills and improper garbage and waste disposal. These are regulated and in most cases no longer pose serious problems. A vast improvement in handling procedures for these materials has been evident over the past few years.

In spite of these improvements there are still several spills each year some of which reach water bodies. The high cost of operating in the north plus the unforeseen problems of weather conditions are incentives to industry to accomplish as much as possible in as little time as possible. Under these pressures, some operators will take calculated risks such as cutting back on environmental safeguards or proceeding when weather and ground conditions are poor. The Fisheries Service has prosecuted 4 or 5 companies in the last 4 years for violations of the pollution section (Sect. 33) of the Fisheries Act when the violation was found to have resulted from negligence on the part of the operator. I feel it is essential that this enforcement effort be maintained if the environment is to be protected.

Once we began to turn our attention to the effects of seismic operations on fish through the use of explosives in 1971, we were immediately faced with a lack of knowledge and experience. We knew very little about the techniques used by industry and the problems associated with them, we knew little about explosives and their effects on fish and in many cases we knew little about

the resource we were responsible for protecting. Our first steps into this field were therefore uncertain and many decisions had to be made based on what little information we had. At the same time we began to gather as much data as we could on the problems associated with the use of explosives and the resource we were working with.

We tried to bias our decisions to be on the safe side in dealing with lakes and streams and in most cases we simply refused to authorize the use of explosives in these systems until we knew more about them and the implications of such programs on them. With very few exceptions, this is still our attitude.

The offshore area of the Beaufort Sea was treated differently. We did not expect very large concentrations of fish to be found in the greatest part of the area (excepting small bays and inlets along the coast) and we felt we could proceed with caution in most of these areas.

Our review of studies that had been done in other parts of the world suggested that there was a threshold pressure generated by explosives, above which fish kills were a certainty. The threshold appeared to be in the area of 40 psi (Hubbs et al 1952). It also appeared that the pressures generated by an explosive could be kept below this threshold by burying the charge in the sea bottom to an adequate depth. Based on these assumptions we began authorizing the use of explosives in areas where water was present below the ice providing the charges were buried according to a formula we set out. At first we required a 5 pound

charge of 60% geogel or equivalent high velocity explosive to be drilled down to a depth of 40 feet (measured from the top of the charge to the sea floor). Every one pound increase in charge size required a further one foot depth above the charge so a 45 pound charge would have to be 80 feet below the ocean floor. This was later revised as more data was received and the present chart being applied is as follows; (Offshore Seismic Seminar, Yellowknife, May 12-13, 1975)

0 -	5 lbs.	60 ft.
5 -	10 lbs.	75 ft.
11 -	25 lbs.	100 ft..
25 -	50 lbs.	125 ft.
50 -	125 lbs.	150 ft.
125 -	200 lbs.	180 ft.

To use the example of a 45 lb. charge as above, it now requires a depth of 125 ft. above the charge as opposed to 80 ft. as originally required. However, because the consistency of the bottom material effects the rate of decay of the pressures generated, it is impossible to predict the pressures which will be generated in the water.

This more stringent requirement can be relaxed in areas we know are not particularly sensitive but are applied in all areas where we are unsure of the sensitivity. We have also begun to permit charges to be set at these depths in some small lakes on the Delta where we do not believe there are fisheries concerns or where the resource is not being utilized by the native peoples. Where we have allowed such shooting we endeavor to monitor the area for signs of fish kill after the

spring thaw but have not found any indications of such kills to date.

Although we are fairly confident that these depth requirements provide adequate protection, we still do not have all of the answers and the data leaves a lot of questions unanswered. We, therefore, continue to be very cautious in granting approvals.

I would like to briefly summarize some of the findings of the studies done to date.

All of the studies found that explosions kill fish. The nature of the injuries are always similar. Professor A.P. Knight reports in "The Effects of Dynamite Explosions of Fish" (1901),

"Post-mortem examination of a large number of these fish all showed similar effects: great capillary hemorrhage from branches of the mesenteric arteries, congestion of the liver and spleen, and invariably rupture of the swim bladder. Portions of the intestines were usually forced dorsally into the cavity of the swim bladder where, of course, there was also much blood. In rare cases, there was rupture of the venous sinuses feeding the auricles."

Further on he says in reference to the swim bladder, "The rupture is evidently due to pressure. When an explosion occurs, there is a sudden liberation of gas tending to produce compression of the water at the site of the explosion. The wave of compression travels outwards in all directions - upwards, downwards and sideways. The direction of least resistance is

of course, always towards the surface of the water - hence the upheaval which follows an explosion. Quite frequently we found three other marked injuries, especially in large fish like pollock. Often in these the liver was compressed into fragments, the ribs were detached from the vertebrae along the whole length, and the flesh (temporal muscle) over the skull, after the skin had been cut, could be raised from the surface of the bone, leaving it as smooth and clean as a piece of polished ivory. Here again the cause of the dislocation of these structures was pressure. The fish is veritably flattened between the compression wave of the explosion on the one side, and the unyielding water on the other; the ribs are torn from their attachments, the liver crushed to pieces and forced backwards into the extra-peritoneal cavity, and the flesh raised clean off the flat bones of the head. The surgeon sometimes meets with similar experience in accidents due to crushing.

No external marks or injuries were visible on any of the fish, in either fresh or salt water."

Professor Knight's study relied on examination of free swimming fish which just happened to be in the study area. Subsequent studies used caged fish at measured distances from the charge and some took pressure measurements in conjunction with the caged fish. None of the studies that I am aware of, however, did any work on sub-lethal effects. Fish which were alive following a blast were either killed and examined for internal injuries or were re-used in subsequent blasts and then killed and

minor internal hemorrhage would eventually recover or if they would die some hours or days later from these injuries or if they might be more susceptible to predators.

Each study done was limited by the environment and species of fish used for each experiment and therefore the findings varied as to the size of the kill area and numbers of fish killed. The method of setting and shooting the charges varied from shots jetted into the bottom to open water shots at various depths and to shots set in ice and frozen in before shooting. All of these variables affected the lethal range of the shots. There are therefore many variables to take into consideration when trying to predict the effect of any given program.

Mr. Ermine A. Christian of the Naval Ordnance Laboratory in White Oak, Silver Spring, Maryland published a study he had conducted in 1973 "The Effects of Underwater Explosions on Swimbladder Fish" in which he put forward the theory that rather than the pressure being the lethal component of an explosion that it was the rarefaction which followed the pressure wave which killed fish. He describes a cavitation effect behind the advancing pressure wave and relates that to the injuries found in the dead fish.

The rarefaction refers to the negative pressures which can be seen on the oscilloscope following the initial pressure wave. Christian (1973) describes this effect and the resulting cavitation. "A typical underwater explosion generates a spherical shock wave. The peak pressure at the front of the outgoing wave

decreases with increasing range. When the shock wave hits the air-water interface at the surface, a tension wave, the inverted image of the outgoing compression wave, is reflected back down into the water. Water cannot support very much tension. When the negative pressure is larger than some critical "breaking" pressure, the water is torn into many bubbles, i.e., it is cavitated."

Mr. Christian points out that the findings of the many studies done are not consistent when considering only the charge size, for example, Hubbs and Rechnitzer (1952) found fish near the surface were killed by pressures lower than those required to kill fish near the bottom.

Mr. Christian reports "Young salmon that were tested by Muir (1959) could usually survive decompressions of about one atmosphere; but when the pressure was lowered to the vapor pressure so that the water cavitated, mortality was high. In contrast to these injuries caused by negative pressures, no ill-effects resulted when Rowley (1955) subjected rainbow trout to positive pressures of more than 13 atmospheres."

(These two studies were not related to explosives.)

Mr. Christian reports that the swimbladder explodes when a fish is within lethal range of an underwater explosion. "Ruptured swimbladders examined in CBL (1948) tests always showed the edges of holes turned outward, and debris from broken blood vessels blown into the abdominal cavity." This contrasts with the reported injuries found by Professor Knight and others.

The question of a negative pressure versus a positive pressure had been considered prior to the NOL study being released. Work done by Gulf Oil in conjunction with the Fisheries Service made us aware of two possible aspects of an explosion other than the peak pressure which may account for the kill. One was the rarefaction or negative pressure and the other was the velocity of the explosive.

When considering the rarefaction as recorded on the oscilloscope there was some question as to whether the values recorded could be interpreted as actual negative pressures at the hydrophone. It was felt that it may be a physical characteristic of the crystal in the hydrophone. Many discussions on this subject between myself and Mr. Elders and Prudholme of Gulf Oil failed to resolve this question. The work done by NOL would certainly seem to verify the rarefaction theory, however, there are still many variables involved and more work would have to be done.

The velocity of the explosive also seems to have an effect on the lethal range of the explosion. It has been demonstrated that black powder is far less lethal to fish than high velocity explosives such as are commonly used for seismic work. This was shown by R.G. Ferguson (1962), Hubbs et al (1952) and others. Ferguson found "Black powder when detonated with an electronic squib, was relatively innocuous to yellow perch." He also says "The nitro charges, on the other hand, were decidedly harmful to yellow perch and other species of fish. Even one pound 51 charge killed some perch at distances

up to 200 ft." In conclusion he states "Initial tests of black powder charges detonated with nitrone primers proved such charges to be most destructive to fish. Subsequent firings of nitrone primers alone indicated that in the black powder - nitrone primer charge the latter component was the lethal agent."

One of the main differences between the black powder and the nitrone charge is the velocity of burning. Black powder has a detonation speed of approximately 2000 ft. per sec. The detonation speed of dynamite ranges from 4,000 ft/sec to 23,000 ft/sec depending on strength, intensity and grade. (M.R. Falk, 1973). This velocity is recorded on the oscilloscope as the time taken to rise to peak pressure. If this is the case, then the peak pressure may not be as critical as the velocity of the charge. It seems, however, that the high velocity powder is necessary to get good seismic recordings and therefore cannot be regulated to any useful extent, although I am still pursuing this subject with industry representatives.

Having considered all of the variables involved and the many questions left unanswered, it still seems reasonable to try to keep the pressures generated as low as possible for any given charge. It is obvious that we do not know conclusively what lethal range a particular size charge will have as the circumstances vary with the site of the program.

In addition to trying to control the pressures generated in the water, we also try to assess the effects of each program on local fish. This is very difficult to do in most cases as the

seismic programs are conducted during the winter months and under ice. In many cases no data is available on the fish resources prior to the program. We try to monitor the area after spring thaw for evidence of dead fish but to date we have not found any such evidence.

We have monitored seismic programs during the summer months when linear explosives such as Aquaflex and Primacord have been used. Linear explosives are high velocity explosives with a water proof casing and are manufactured as a cord and sold on reels. This method reduces the actual charge size by spreading the charge over a large area. For example, 165 feet of Aquaflex 200 grains per foot is equivalent to 4.9 lbs. of geogel. Its detonation speed is 20,350 ft/sec. We have observed what could be called minor fish kills in the area of 10 to 20 fish per shot. A major difficulty even in summer months is in determining how many of the fish killed float as opposed to those which sink.

Studies which addressed this problem come up with varying results. Fitch & Young (1947) indicate a ratio which varied from 1/1 to 12/1 floaters/sinkers. Knight (1907) found 1/3 of the fish killed floated. The studies were done with different species and this may explain the variations. No similar work has been done with species found in the N.W.T. and Beaufort Sea to my knowledge.

The study done by M.R. Falk (1973), then with the Fisheries and Marine Service, looked into the effects linear

explosives on fish. The manufacturers brochures on the explosive indicated little or no lethal effects on fish and no independant studies had been done to my knowledge prior to 1973. Falk's results indicated "From the combined results of experiments 1 and 2 it was evident that fish near the surface were more susceptible to injury than those near the bottom." Falk later describes the lethal area for a given size of charge as "The LR50's (Lethal Range for 50% of the test organisms) were found to be 50 and 12.5 ft. at depths of 3 and 7 ft., respectively for the combined results of experiments 1 and 2. These values were used as reference points to define the lethal zone surrounding the Aquaflex charge. This zone was extapolated to the surface at a horizontal distance of 80 ft. The lethal areas at a depth of 7 ft., 3 ft., and at surface were calculated to be 6,500, 16,500 and 36,200 ft.² respectively. The lethal volume associated with 165 ft. aquaflex charge detonated on the bottom at a depth of 10 ft. was then 185,000 ft.³

It can be seen from the data available that explosives are lethal to fish even when used in relatively small charges such as are found in the linear explosives. The area affected by a given charge varies according to the size of charge, type of powder, method of setting and shooting employed, bottom and water conditions at the site. The effect of the charge on fish varies according to the species of fish present, abundance of fish present, as well as the depth at which the fish happens to be, distance from and orientation of the charge. Furthermore, it has been reported (Fitch & Young 1947 and Knight 1907) that

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fish are not frightened away by a blast. It is possible that some species may even be attracted to the site of a blast to feed on the dead and injured fish.

Less is known of the effects of explosives on sea mammals than for fish. Fitch and Young (1947) report at least three occasions when California sea lions were killed but California grey whales observed in the area of the blast were seemingly unaffected. The Fisheries and Marine Service, Arctic Biological Station has endeavored to study this problem with ring seals. The study can only be viewed as a preliminary assessment at this point and no plans have been made for further work. The report on the work done during the summer of 1975 by Dr. T. Smith has not been published as yet but the results were relayed to me through personal communication with Dr. Smith. Briefly, out of 6 seals held at distances varying from 50 ft. to 500 ft. from a 50 pound charge of 60% geogel only one of the animals had any outward signs of injury. The animal at the 50 ft. station developed a nose bleed following the blast but post mortem examination did not indicate the injury was serious and it was felt that the seal would have recovered.

From the little evidence available and taking into consideration the density of seals in any given area it seems unlikely that a seismic program could significantly affect the seal population by way of the immediate lethal effects on the animals. This does not preclude the possibility that the disturbance caused in the area might affect the behavioral patterns of the animals so as to cause them to abandon the area.

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This could have a significant impact if it happened in an area where suitable alternative sites were not available or if it caused females to abandon pups or pupping sites. During years when the animals are under stress through natural circumstances the effects could be amplified even more. These are certainly interesting possibilities to examine but they are extremely difficult, and perhaps impossible to test.

Fitch and Young (1947) also report incidents of deaths of sea birds, particularly those that dive for food, when the birds happen to be submerged when a shot is fired. We have not observed any comparable incidents with the programs we have monitored to date. This is probably a further indication that no fish kills of any significance have resulted as it is the dead fish that attract the birds to the area. On the few occasions where we did find fish floating after a seismic shot, we suspended the shooting operations.

In summary then, the use of explosives in waters where fish are found, poses a threat to local populations and must be protected. We are at present, providing this protection by requiring shots to be buried in the bottom thus keeping pressures as low as possible, encouraging the use of smaller charges, encouraging industry to utilize other energy sources wherever possible and by encouraging investigations by industry into the development of less biologically offensive dynamite.

I would like to conclude by mentioning briefly some of the non-explosive energy sources. These include:

Flexotir - a small 2 oz. explosive charge detonated in a perforated cast iron spherical shell or cage.

Vibroseis - hydraulically generated vibrations are directed toward the sea bed by means of transducers.

Hydrosein - this system generates a powerful energy wavefront by means of implosion created by a massive cavitation through the action of a piston in a piston chamber.

Gas source seismic profiles - ignition of a mixture of acetylene and oxygen in a rubber tube which exerts a pressure of about 300 psi.

Dinoseis -- this uses a mixture of propane and oxygen ignited in an expandable chamber. The exhaust gases are vented to the surface.

Flex-O-gun- similar to Dinoseis but the propane mixture igniting works against a moveable piston.

Aquapulse - propane and oxygen are ignited in an elastic walled container.

Sparker - high voltage condensers discharge electrical energy into cables towed behind a vessel. Discharge through electrodes in the water cause formation of steam bubbles.

Wire Exploder - modified and more efficient version of the Sparker.

Hydrosonde - similar to echo sounding using a spark, ignition of gases or water displacement to create high energy sound pulses.

Vaporchoc -- energy is released when a bubble of steam collapses and hydrostatic pressure causes rapid inflowing of water.

Par Air Gun - high pressure release of air directly into the surrounding medium.

See Falk & Lawrence (1973) for further descriptions of these systems.

These systems with the exception of the air gun are not being used in the N.W.T. for various technical and logistical reasons. They do not produce suitable recordings in this area or the equipment is too large and bulky to use in shallow water where size of boats is restricted. Winter operation is hampered by freezing and breaking of the equipment which must be immersed and withdrawn from the water many times in each line.

The air gun has been used quite extensively in deep water (10 ft. or deeper) in the Beaufort and has been found to produce acceptable seismic data. The equipment is large and is usually mounted on large vessels which limits its use of water over 20 ft. deep; Falk conducted a brief study of the airguns' effect on fish. His results show a lethal radius for a 300 cubic inch to be between 2 and 5 feet. We have encouraged the use of this method wherever it is feasible and we feel quite confident that it has little or no effect on the fish in the area of its use.

In September of 1974 a fish kill off Toker Point was reported to us. We investigated the report and found no sign of dead fish as the ice had formed before we got to the site. Mr. John Raddi, who initially found the kill, had collected several specimens, however, and these were sent to the Freshwater Institute in Winnipeg for autopsy. The results could not give a cause of death however it did discount explosives as a possible cause.

In January of 1975 another kill was reported off Atkinson Point and again samples were collected and sent out for autopsy. Examination of these fish failed to determine the cause of death but again discounted explosives. It is interesting to note that similar fish kills had been observed in the past by Mr. Raddi Kowalchuk and Mr. Charlie Gruben both residents of Tuk, and others. It appears that such kills may be a natural phenomenon.

It has been reported that large number of fish may become subjected to a super-cooling effect when ice crystals form suddenly in the water. This cooling in turn causes the formation of ice crystals in the blood of the fish resulting in rupturing of blood vessels particularly in the gills. The samples which were sent to Winnipeg from the Atkinson Point kill were examined for signs of this phenomenon. Although some minor gill damage was noted, the formation of ice crystal in the blood was discounted as the cause of death. The damage to the gills was attributed to a post mortem effect.

There had been an airgun seismic program off Toker Point prior to that kill being reported but our records do not show any programs off Atkinson Point. Our investigation of the operator who was working off Toker Point did not produce any evidence of the use of explosives and the operator assured us that air guns only were used.

I believe further studies of the airgun's effect on fish are warranted. These should include use of array as well

as single guns and sub-lethal as well as lethal effects on fish.

ENFORCEMENT

The role of the Fisheries and Marine Service in the N.W.T. is a management/enforcement role. Traditionally, the management role was viewed as a research function and enforcement was seen as a "tool" of management. I disagree with this philosophy and over the past few years I have been able to advance the idea that enforcement is an integral part of management. The best conceived management program is only as successful as the enforcement staff's ability to implement it. Because our staff in the N.W.T. is made up primarily of enforcement officers, decisions regarding commercial quotas, catch and possession limits for anglers and regulations generally are made by the enforcement officers, acting on advice of our professional staff at the Freshwater Institute in Winnipeg.

Part of managing any renewable resource involves the protection of habitat. Prior to 1970/1971 this was not a major part of the enforcement role. As industrial activities such as oil and gas exploration, mining and highway construction increased, the need for active participation in the approval system became obvious. Consequently, a major part of our activities are now directed to this field.

The officers that are working in the N.W.T. are for the most part experienced in many diverse subjects. This experience has been gained through actual involvement with the development over the past four years and is a continuing growth situation. We have been fortunate in experiencing a low incidence of staff turnovers and I attribute that to

the dedication of the individuals involved and to the flexible policies of this department. Although many people within our department dislike the police image, in fact our agency is a police force. The officers receive training in all aspects of crime investigation and legal procedures and a continuing program of upgrading in this field is necessary.

The Fishery Officer is called upon to investigate reports of pollution, violations of fisheries regulations and violations of permit conditions and he is expected to take whatever action is called for quickly and efficiently often without the benefit of advice from senior officers. If a prosecution is to be considered, the evidence must be collected as soon as possible after the violation occurs and it must be handled in a manner acceptable to the courts.

The decision to institute prosecution proceedings is usually made by the investigating officer. In complex cases involving lab reports, photographic evidence, expert witnesses and statements and other documentary evidence the decision to prosecute is usually made in consultation with the Chief of Enforcement. The decision is usually a complicated one to make with consideration being given to all of the evidence involved, the applicable legislation and a weighing of the alternatives. The decision is never taken lightly.

The objectives must always be foremost in the officers mind. These are to protect the habitat and to ensure the continued well being of the resource. Constant surveillance

is required to keep up with the many activities going on simultaneously throughout the year. This requires a considerable budget for travelling, in most cases by charter aircraft. We make use of industry funded transportation and accommodation as much as is possible but independent funding is still required if thorough surveillance is to be maintained.

Legislation generally trails industrial development leaving the enforcement officer having to apply general legislation to specific problems which may not have been foreseen when the legislation was enacted. A good example is the application of Section 33(2) Fisheries Act in cases involving oil spills. There are often many pieces of legislation which may apply in any given situation and it is necessary for the agencies involved to coordinate their approach to the problem. This has not been a serious problem to date, however, it should be born in mind as new regulations are being considered.

Government must address itself to cleaning its own backyard as well as that of its industrial neighbors. There is some effort being made right now through controls of Federal facilities and research into waste treatment equipment for small communities but there are still examples around of poor housekeeping by government agencies and crown corporations. Fuel storage facilities at DEW line sites for example were substandard as of last year. ^{Standard elsewhere} One fuel spill in Yellowknife in 1972 which continued to release oil into Great Slave Lake for

3 years involved a Crown Corporation. I was advised then that I could not take legal action against a Crown Corporation. The expense of clean-up was born by government. I feel it is incumbent upon government to conduct its own affairs in an exemplary manner and to set the example for industry.

When drafting legislation which is meant to apply to the protection of natural resources from the side effects of industrial development, I feel it is desireable to separate the regulations according to the degree to which enforcement is to be carried out. For example, where technology is not yet available to completely remove specific substances from an effluent, regulations which strictly prohibit the discharge of that substance may not be desireable. Alternatively a maximum concentration may be stipulated with a compliance schedule to meet the ultimate desireable level. Another alternative may be to issue guidelines for the interim period while research and development of treatment facilities is underway.

Once regulations are passed they should be enforced impartially. The enforcement officer must exercise some discretion in his investigation and preparation of the case but the decision as to whether to proceed with a prosecution should be a question of law and not subject to administrative or executive influence. The use of a threat to prosecute to achieve compliance by a violator ^(or by threat) is synonomous with blackmail and denies the accused the right to defend himself in the proper public forum, the courtroom. On the other hand the

public has a right to know what is happening and that the agencies responsible for enforcement of the regulations are doing their jobs.

Penalties provided for violations of some legislation are not usually a deterrent to large companies. The Fisheries Act for example provides for a \$1000 fine for most offences and \$5000 fine for offences against Section 33, the pollution section. There is also the possibility of a charge on each day the offence occurs or continues. The amounts of fines received to date have varied from a few hundred dollars to \$10,000 which are not very significant in comparison to the profits of most large companies. The greatest deterrent is usually the public exposure that results from the case. Rather than raising the level of fines however I would prefer to see the courts order the offender to cover the cost of clean-up and restoration or to contribute to the development of improved technology.

This philosophy may be overly simplifying a complex problem but the objective as I see it is to have the administration of the regulations as open as possible and to achieve a standard approach to justice which will ensure the impartiality of the enforcement program.

- Rasmussen, B. 1967. Effect of Underwater Explosions on Marine Life.
- Roguski and Nagata. 1970. Observations on the Lethal Effect of Under Ice Detonations on Fish.
- Rulifson and Schoming. 1963. Geophysical Offshore Oil Explorations and Associated Fishery Problems.
- Weaver and Wienhold. An Experiment to Determine If Pressure Pulses Radiated by Seismic Air Guns Adversely Affect Immature Coho Salmon.

Hugh Robert Trudeau
Chief of Enforcement (PM4)
Western Region
Fisheries and Marine Service

Resume of Experience

Academic Achievements: High School - Manitoba & Alberta

Military Experience : 3 years RCN 1959-1962
ABAF 46508-H

Career Progress:

- 1967-1969, Dept. of Fisheries - casual positions in enforcement and technical capacities.
- 1969-1970, GT 1 Enforcement Officer - Dept. of Fisheries.
- 1970-1972, GT 2 Enforcement Officer - Fisheries and Marine Service.
- 1972, GT 3 Head of Environmental Control Section - Fisheries and Marine Service.
- 1972-1975, GT 4 Officer-in-Charge Western Subdistrict - Fisheries and Marine Service.
- 1975-1976, Chief of Enforcement - Fisheries and Marine Service, Western Region.
- 1976- , Acting District Manager, Fisheries and Marine Service.

Advanced Training:

- Management Course for supervisors
- Effective Report Writing and Oral Communications
- Law Enforcement Course - Vancouver Police Academy
- St. John Ambulance - Advanced First Aid
 - First Aid Instructor
 - Training Officer - N.W.T.
- Canada Emergency Measures Organization
- Arctic Survival Training
- In-service Job Description Writing Course

Associations:

Executive Council - Northwest Wildlife Law Enforcement Association.

Publications:

Fishery Officers Manual (1975).

Offshore Seismic Seminar
Yellowknife, N.W.T. - May 12-13, 1975

Summary:

I have been involved for the past eight years in Fishery Management at all levels with particular emphasis on regulations and law enforcement. I have been associated with other agencies responsible for wildlife management, non-renewable resource management (4 years as representative on Land Use Advisory Committee) and I have several years of experience in training both as instructor and program manager both with Fisheries and Marine Service and St. John Ambulance. Much of my work has been with Native Canadians both Indian and Inuit peoples in The Northwest Territories where I have resided for the last ten years.

H. R. Trudeau

